



CBCS SCHEME

18AE54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023 Introduction to Composite Materials

Time: 3 hrs.

Max. Marks: 100

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Assume missing data suitably.*

Module-1

- 1 a. Define a composite material. Explain how composites are broadly classified. (10 Marks)
b. Differentiate between thermosetting and thermoplastic polymer. (06 Marks)
c. Write a note on laminated composites. (04 Marks)

OR

- 2 a. Explain the following methods of processing MMC's:
(i) Solid state processing (any one method)
(ii) Liquid state processing (any one method) (16 Marks)
b. List the properties of MMC. (04 Marks)

Module-2

- 3 a. Discuss the filament winding technique of preparing laminated composites with neat sketch. (10 Marks)
b. Explain the pultrusion process with neat sketch. (10 Marks)

OR

- 4 a. Explain with neat sketch the injection moulding process. (08 Marks)
b. Explain Laser beam cutting of composites with neat sketch. (08 Marks)
c. Write a note on Adhesive bonding. (04 Marks)

Module-3

- 5 a. Using strength of material approach, derive expression for effective axial modulus, and major Poisson's ratio of a UD lamina. (12 Marks)
b. A glass/epoxy lamina consists of a 70% of fiber volume fraction. Assume the density of fiber and matrix are $\rho_f = 2500 \text{ kg/m}^3$ and $\rho_m = 1200 \text{ kg/m}^3$ respectively. Determine:
(i) Density of composite
(ii) Mass fraction of glass and epoxy
(iii) Volume of composite lamina, if the mass of lamina is 4 kg
(iv) Volume of fiber and epoxy
(v) Mass of fiber and epoxy (08 Marks)

OR

- 6 a. Derive the stress-strain relationship for a 2D unidirectional angle lamina in its global and local axes. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

- b. For a 60° angle lamina of graphite/epoxy as shown in Fig.Q6(b). Find the: (i) Compliance matrix (ii) Global strain. If the applied stress are $\sigma_x = 2$ MPa, $\sigma_y = -3$ MPa and $\tau_{xy} = 4$ MPa, find: (iii) Local stress (iv) Local strain. The properties of the lamina are $\gamma_{12} = 0.28$, $G_{12} = 7.17$ GPa, $E_1 = 181$ GPa, $E_2 = 10.3$ GPa.

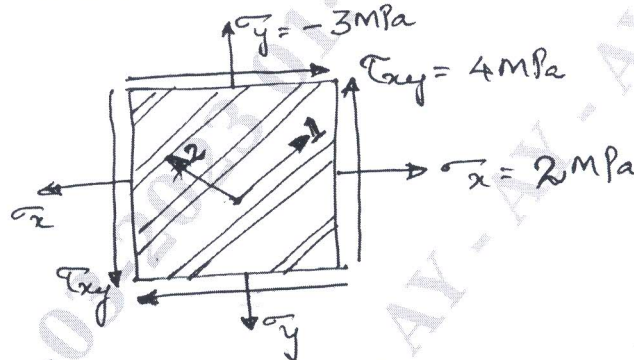


Fig.Q6(b)

(10 Marks)

Module-4

- 7 a. Write a note on Tsai Hill theory and Tsai-Wu failure theory. (10 Marks)
 b. Find the maximum value of $s > 0$ if a stress of $\sigma_x = 2s$, $\sigma_y = -3s$, $\tau_{xy} = 4s$ is applied to the 60° lamina of graphite/epoxy. Use maximum stress failure theory and the properties of unidirectional lamina are $E_1 = 181$ GPa, $E_2 = 10.3$ GPa, $(\sigma_1)_{ult} = \pm 1500$ MPa, $(\sigma_2)_{ult}^T = 40$ MPa, $(\sigma_2)_{ult}^C = -246$ MPa, $(\tau_n)_{ult} = \pm 68$ MPa. Also find the maximum stress that can be applied before failure. (10 Marks)

OR

- 8 a. Derive A, B and D matrix by considering force, stress-strain and moments. (10 Marks)
 b. Find A, B, D matrices for the 2 ply laminate as shown in the Fig.Q8(b). Assume both the laminate have identical stiffness matrix Q as follows:

$$[Q] = \begin{bmatrix} 13 & 2.5 & 0 \\ 2.5 & 1 & 0 \\ 0 & 0 & 3.5 \end{bmatrix} \text{ GPa}$$

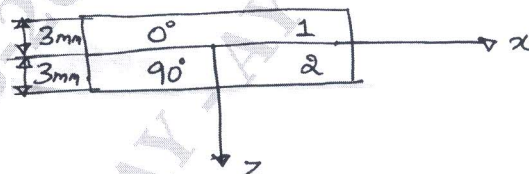


Fig.Q8(b)

(10 Marks)

Module-5

- 9 a. Suggest the experimental setup to test composite for tension and shear properties. (10 Marks)
 b. Explain the application of composites in Aircraft field. (10 Marks)

OR

- 10 a. Explain ultrasonic testing of composites. List its advantages. (10 Marks)
 b. Discuss the application of composite in sports and automobile fields. (10 Marks)
